

MARCH 6.

MR. GEO. W. TRYON, JR., in the chair.

Twenty-six persons present.

Permian Fishes and Reptiles.—Prof. COPE exhibited some specimens of fishes and reptiles from the Permian formation of Texas. One of these was a new species of Crossopterygian fish which he named *Ectosteorhachis ciceronius*, which exhibited some important characters of the posterior cranial region. He stated that the base of the skull consists of ossified parachordals, and these embrace the chordadorsalis posteriorly, and are continued for a short distance posteriorly as a tube. Anteriorly the chordal groove is open. Trabeculæ not ossified. He considered the cranial structure to be an excellent illustration of a permanent embryonic type.

The most interesting reptile was a new genus which occupies a place between the *Pelycosauria* with molar teeth, and those with raptorial teeth, but with more resemblance to the former, or *Dialectidæ*. The teeth are placed transversely in the jaws, but the crowns terminate in an incurved apex, without ledge. He named the genus *Chilonyx*, and referred it provisionally to the *Bolosauridæ*. The typical species is the *Bolosaurus rapidens* (Cope, 1878), an animal with a skull as large as that of a hog, and with robust limbs. The surface of the skull is divided by grooves into numerous swollen areas, and some of these are, on the lateral occipital region, developed into tuberosities like the rudimental horns of the *Phrynosoma douglassi*.

Phenomena of Glaciation.—Professor HEILPRIN, referring to his former communication on the phenomena of glaciation, stated that if the principles laid down by him as to the limitation (in height) of a polar ice-cap be correct, then the same principles must likewise hold good for all portions of the earth's surface. In other words, given an elevation of sufficient magnitude, then the upper portion of the same, by virtue of its rising above the cloud-line, must be either bare of snow or covered only with a comparatively feeble thickness of the same. This view, which the speaker believed was first enunciated by Humboldt, receives confirmation from observations made on the Alps and on other high mountain peaks. Thus, according to Tschudi, only a comparatively very feeble thickness of snow falls on the Alpine summits above an altitude of about 10,800 feet, the heavy precipitation being principally confined to a zone comprised between 7000 and 9000 feet. The brothers Schlagintweit determined the cumulus line in the

same region to lie at a general elevation of 8-9800 feet, above which storms were of only exceptional occurrence, and the atmosphere usually clear and serene. These observations as to feeble precipitation were further confirmed by Dollfuss, who found that on the Théodule Pass (10,800 feet) the total precipitation for the six winter months amounted to only $7\frac{1}{2}$ feet of snow. On the St. Gothard, on the other hand, at an elevation almost exactly 4000 feet lower, nearly the same quantity fell in a single day. Again, on the Grimsel (6150 feet) Agassiz found the winter snow-fall to amount to $57\frac{1}{2}$ feet. While, therefore, the highest Alpine summits generally appear to be buried in an almost unfathomable thickness of snow, there can be but little doubt that in actual fact this thickness is but very moderate. This is proved by the circumstance that under exceptional conditions the snow covering may almost completely disappear as a result of a single season's melting. Thus in September, 1842, the Ewigschnee-horn was completely dismantled of its cap, and in 1860-1862 a whole series of the usually snow-clad peaks showed only patches of snow. During the same period the Stralech (11,000) feet could be crossed without the traveler encountering a single patch of either hard or soft snow (Reclus). With these facts before us, we have good grounds for doubting whether any extraordinary accumulation of snow, unless with a much warmer climate, could take place in the region of the far north (with a descending cloud line) on elevations of very great magnitude. Granting, however, the possibility of a huge polar glacier tending southward, some singular facts are brought out by a calculation of its rate of progression. Allowing an average rate of one foot per day, which is about that of the average Alpine glacier, it would necessitate for a glacier starting from about the sixty-fifth parallel of latitude a period of no less than 25,000 years for it to have reached the line of its terminal extension, the terminal moraine. But with such an infinitesimal slope as such a glacier must necessarily have had, it may be questioned whether its rate of progression would have been more than one-fifth or even one-tenth of that which has been here given it. At the average rate of two and one-half inches daily, 125,000 years would have been required for its southerly progression, a period that would nearly tide over the interval between the periods of greatest eccentricity indicated by astronomers.

Professor LEWIS remarked that arguments drawn from meteorological conditions as they now exist will not in all cases apply in considering the glacial epoch. The distribution of land and water was so different in glacial times that meteorological conditions must also have been different. He instanced facts which he had observed in the valley of the Delaware and elsewhere, indicating a depression south of the glaciated area, which produced a greater water surface in the glacial epoch, and therefore different meteorological conditions. He remarked also that it was unsafe to found arguments upon any close analogy between the conditions of local

glaciers or isolated peaks and the great ice sheet of the glacial epoch. While analogies might be drawn from the glacier of interior Greenland or from the Antarctic ice-cap, he thought that errors often arose from a too close comparison with more local centres of glaciation.

Referring to the subject of glacial motion, Professor LEWIS said that while there were not yet sufficient facts at hand to determine its rate, its general direction and continuity were clearly shown in the striæ on elevated summits. He spoke of the importance of distinguishing these high-level striæ from those occurring in valleys, remarking that erroneous conclusions had frequently been drawn from an examination of maps of striæ, where the relative elevation of the individual striæ was not noted. While the striæ upon mountain summits indicate the general direction of the top of the ice, and are uniform over large areas, those in valleys show merely the local movement of the lower strata, and, conforming more or less to the direction of the valley in which they occur, vary in each locality and are therefore of minor importance. As an instance he described some striæ near White Haven, Luzerne Co., Pa. Those in the valley of the Lehigh near the town bore S. 35° E. or approximately down the valley, while on the other hand, upon the summit of Penobscot Knob, 1100 feet higher than the valley (2250 feet above the sea), the striæ bore S. 10° W., this being the general direction of ice-flow across northeastern Pennsylvania. In all cases the striæ are at right-angles to the terminal moraine, and they therefore point S. E. in western Pennsylvania. He gave other facts which he had observed in Pennsylvania and elsewhere, all pointing to the continuity of action and consequent great size of the glacier. He spoke of the probable analogy between the Antarctic ice-cap, some 2500 miles in diameter, and the Polar ice-cap of glacial times, and mentioned Croll's estimate that the former is twelve miles thick at its centre. In speaking of a Polar ice-cap, he did not mean to imply, however, that the ice was necessarily thickest on the Pole. As in Europe the mountains of Scandinavia and Scotland were probable centres of glaciation, the glaciers from which joined to form the great *mer-de-glace*, so in America either Greenland, Labrador, the Hudson Bay region, or elsewhere, may have been centres from which glaciers grew finally to coalesce into one mass of ice, the top strata of which flowed southward to the great terminal moraine.

MARCH 13.

The President, Dr. LEIDY, in the chair.

Thirty-nine members present.

The death of Henry Seybert, a member, was announced.